Space Weather Forecast

Issued on Friday, 15 December 2023 at 01:31 Local

This forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: High activity with further Moderate flares likely, and chance of Strong flares (R1-R3). G1 Minor Storms possible from Coronal Mass ejection arrival day 2 (16 Dec). Further analysis required on 14 Dec Strong flare CME, but perhaps a chance of G1-G2 day 3 (17 Dec).

Analysis of Space Weather Activity over past 24 hours

Solar Activity: High with a strong flare from the complex sunspot in the northwest disc, peaking 14/1702 UTC. This was the largest flare so far of the current solar cycle, and the largest since Sep 2017. Two Moderate flares were also observed from this region. This is a complex and moderately sized sunspot group approaching the northwest limb, which saw ongoing growth and development through the last 48 hours. Since the strong flare, development of the region has continued and further flares are possible. This is one of seven other active regions on the disc, however the other regions are largely smaller and simpler, with no significant growth observed.

Two CMEs were observed in the last 24 hours with potential Earth-directed components. The first was due to an eruption across the northern hemisphere, starting 14/1109 UTC, and the second was from the Strong flare. The first has yet to be analysed due to a lack of imagery, however sufficient low quality images of the second CME have enabled a preliminary assessment of it. This is mainly passing ahead of Earth, but with a potential arrival early on day 3 (17 Dec). Any other CMEs in the last 24 hours have been assessed as not having earth-directed components

Solar Wind / Geomagnetic Activity: Solar winds were indicative of the tail end of a passing weak coronal mass ejection, which had arrived late on 13 Dec. Speeds persisted at background, near 350 km/s. The interplanetary magnetic field (IMF) was initially Moderate but eased to be Weak. The north-south component was generally negative (southward) initially Moderate, but eased to be Weak. Geomagnetic activity was initially Unsettled to Active (Kp 3-4), but eased to be Quiet from 14/1500 UTC (Kp1-2).

Energetic Particles / Solar Radiation: The count rate of energetic particles (high energy protons) rose slightly above background after the strong flare, but remained well below the S1 Minor Radiation Storm Level, although with a rising trend.

Four-Day Space Weather Forecast Summary

Solar Activity: Moderate to High activity expected with the ongoing likelihood of Moderate class (R1-R2) flares and a chance of further isolated Strong class (R3) flares from the complex sunspot region in the northwest. This risk recedes later day 3 and through day 4 (17-18 Dec) as the region moves further around the far-side.

Solar Wind / Geomagnetic Activity: There are two Earth-directed CMEs arrivals expected. The first from 13 Dec filament eruption near the complex sunspot in the northwest, early on day 2 (16 Dec), and the second from the Strong flare on 14 Dec. This second one still requires further analysis, however a preliminary arrival time has been estimated for early day 3 (17 Dec). Otherwise coronal hole fast winds may bring a weak enhancement on day 1 (15 Dec) with solar winds perhaps rising to around 450 km/s, while a further coronal hole has the potential to

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enhance winds on day 4 (18 Dec), although this is very low confidence. Overall, geomagnetic activity is forecast to be Quiet at first, rising to Unsettled to Active with coronal hole enhancements day 1 and day 4 (15 and 18 Dec), with a slight chance of G1 Minor Storms. The CME arrival early on day 2 (16 Dec) brings a chance of a spell of Active to G1 Minor Storm intervals. The CME arrival on day 3 (17 Dec) is less certain, but could bring G1-G2 Minor to Moderate storms.

Energetic Particles / Solar Radiation: The count rate of energetic particles (high energy protons) is expected to continue rising for a time day 1, with a slight chance of reaching the S1 Minor Storm levels. Any further significant flares from the complex sunspot will increase this risk, leading to an ongoing chance of reaching this level through the period.

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Geomagnetic Storms:

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	10	40	40	10
Strong	G3	No	1	15	15	1
Severe	G4	No	1	2	2	1
Extreme	G5	No	1	1	1	1

Radio Blackouts - X Ray Flares:

X Ray Flares Probability	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	R1-R2 M Class	Yes	70	70	60	50
Very Active	R3 to R5 X	Yes	30	30	20	5

Solar Radiation Storms - (High Energy Protons):

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	≥ S1	No	30	25	25	20
Very Active	≥ S3 *	No	5	5	5	5
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

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